Monetary Policy Transmission in the Euro Area

A Study by the Eurosystem Monetary Transmission Network

Edited by

Ignazio Angeloni, Anil K Kashyap
and Benoît Mojon

CAMBRIDGE
UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge, CB2 2RU, UK
40 West 20th Street, New York, NY 10011–4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa

http://www.cambridge.org

First published 2003

Printed in the United Kingdom at the University Press, Cambridge

Typeface Plantin 10/12 pt. *System* LaTeX 2$_\varepsilon$ [TB]

A catalogue record for this book is available from the British Library

Library of Congress Cataloguing in Publication data
Monetary policy transmission in the Euro area : a study by the Eurosystem Monetary Transmission Network/edited by Ignazio Angeloni, Anil Kashyap and Benoît Mojon.
p. cm.
Includes bibliographical references and index.
ISBN 0 521 82864 3
1. Monetary policy – European Union countries. 2. Transmission mechanism (Monetary policy) 3. Euro. I. Angeloni, Ignazio, 1953– II. Kashyap, A. K. III. Mojon, Benoît. IV. Eurosystem Monetary Transmission Network.

HG3942.M66 2003
332.4′6 – dc21 2003043966

ISBN 0 521 82864 3 hardback

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1 Some stylised facts on the euro area business cycle

A.-M. Agresti and B. Mojon

1 Introduction

There is a long tradition of describing the main regularities in the economic fluctuations by reporting the standard deviations and cross-correlations of de-trended macroeconomic time series. Economists, originally mostly contributors to the Real Business Cycle (RBC) research programme, have then used these cyclical properties as benchmarks to discriminate across competing theoretical models. Against this background, the cyclical properties of the US economy (Stock and Watson, 1999) and other OECD countries (Baxter, 1995) are well documented. On the contrary, no study has yet described systematically the cyclical properties of the euro area.

This chapter fills this gap by compiling the moments of de-trended euro area macroeconomic time series. For comparison, we also report similar statistics for the USA and for euro area countries.[1]

We find that the cyclical properties of the euro area and the USA are surprisingly similar in mainly three respects: the magnitude of the fluctuations in consumption, investment, prices, inflation, interest rate and monetary aggregates relative to the fluctuations of GDP; the patterns of cross-correlation of GDP components, prices and interest rates with respect to GDP; and the persistence of GDP and of prices.

We also describe the high synchronicity of national cycles and the euro area aggregate cycle. This synchronicity is observed for the main GDP components as well as for the short-term interest rate. It is particularly high for the largest countries of the euro area and for Austria, Belgium and the Netherlands, which belonged to the core ERM.

The authors are extremely grateful to Alistair Dieppe and Jérôme Henry for providing us the data from the euro area AWM, as well as for sharing their procedures to built historical series for the national account variables; and to Don Bredin, Sophocles Brissimis, Raf Wouters and Luisa Farinha for providing us with quarterly national account data for respectively Ireland, Greece, Belgium and Portugal.

[1] There are no quarterly national accounts available for Luxembourg and Irish quarterly national account data are available for too small a sample period.

The analysis is conducted in five steps. We explain how we de-trend the data in section 2. Section 3 briefly reviews the data we use and describes how the area-wide data are constructed. In section 4, we evaluate the synchronicity of the euro area aggregate cycle with the national cycles and compare the cyclical properties of euro area synthetic data constructed with different aggregation approaches. In section 5, we compare the euro area and US business cycles. Section 6 concludes.

2 Our favourite filter for the European macroeconomic time series

To facilitate a comparison with Stock and Watson's (1999) comprehensive study of the US business cycle, we de-trended our data using a band pass filter developed by Baxter and King (1999) (BK). As Stock and Watson note this transformation keeps 'those movements in the series associated with periodicity within a certain range of business cycle duration'.[2] We slightly deviate from Stock and Watson in two respects.

First, we allow the upper bound on the length of the business cycle to be forty quarters (ten years) instead of thirty-two (eight years). We see several reasons why this seems reasonable. To begin, the associated trend we extract is less likely to have a cyclical pattern (Rotemberg, 2002). In addition, while Stock and Watson refer to the NBER business cycle reference dates whereby most cycles from trough to trough experienced by the US economy last between eighteen months and eight years, the euro area only saw three recessions since 1970. And actually, the intervals between the last three US recessions, which took place in 1982, 1991 and 2001, lasted for about ten years. Hence, we felt it was appropriate to include 'frequencies' as low as ten years into our 'business cycle component'. Finally, the spectral densities of GDP growth quarterly time series, reported in figures 1.1 and 1.2, indicates that the peak of the variance has shifted lower when the sample is extended to the second part of the 1990s.[3]

Our second deviation from Stock and Watson is to truncate the band pass filter at eight leads and lags (instead of twelve for Baxter and King and Stock and Watson). As many of the series we consider start only in the 1980s or the mid-1970s, we thought we could not afford a twelve leads and lags truncation because it would mean losing six years of data. The

[2] See appendix 2 in Agresti and Mojon (2001) for a brief discussion on recent literature on filtering and a description of the Baxter and King band pass filter.

[3] These spectral densities were estimated with a Bartlett window of width 8. We thank Luca Sala for providing these estimates.

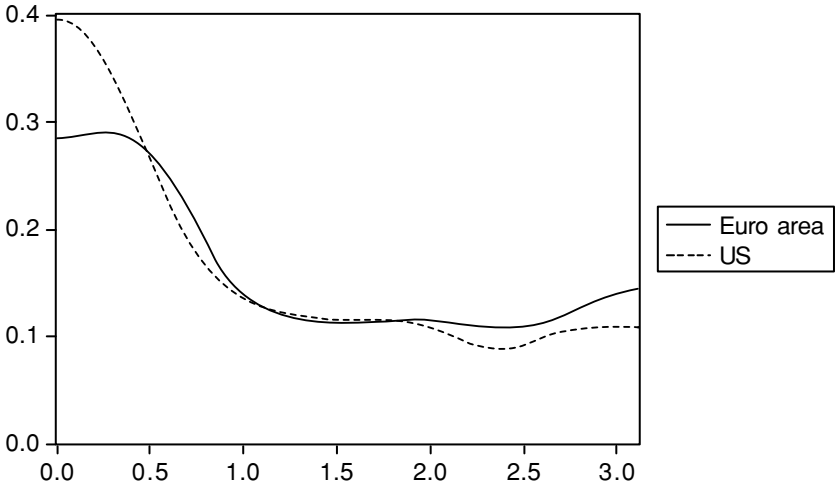

Figure 1.1 Spectral densities of GDP growth, 1970–2000, in the euro area and the USA

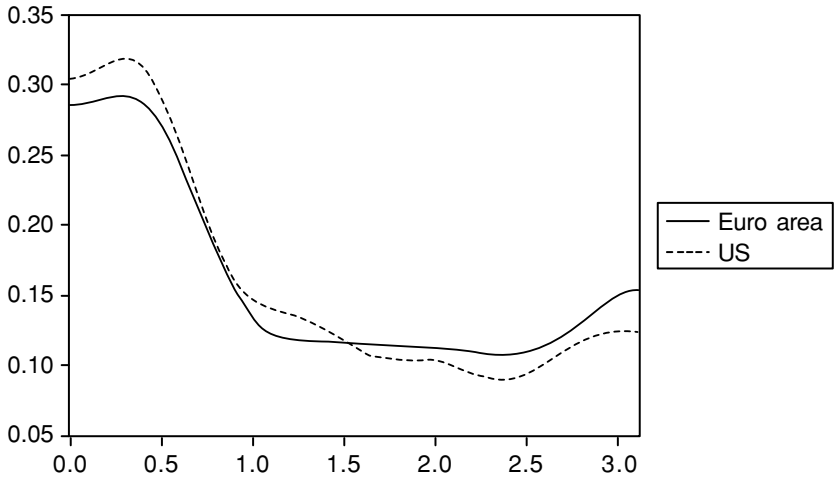

Figure 1.2 Spectral densities of GDP growth, 1970–1995, in the euro area and the USA

sensitivity analysis in Agresti and Mojon (2001) presents the effects of these two deviations from the Stock and Watson version of the Baxter and King filter and also compares the outcome with the Hodrick–Prescott filter applied to the a sub-set of macroeconomic time series. Section 5 also reports robustness checks of some of our results with regards to the method used to de-trend the series.

3 Data

We analyse the business cycle components of twenty-four series for the euro area aggregate and the USA.[4] The variables[5] belong to six main categories: GDP components and other activity indicators such as industrial production and unemployment, price level indices, money and credit aggregates, market and retail bank interest rates, exchange rate and asset prices. At the level of euro area member countries, the analysis is limited to GDP, consumption, investment and short-term interest rates.

Euro area variables are actually euro area aggregates (euro area less Greece, which joined EMU in 2001). These variables come from the current version of the Euro Area Wide model (AWM), which has been constructed by the staff of the Econometric Modelling Division of the ECB. The aggregation has been done with fixed weights, based on 1995 PPP GDP.[6] As a robustness check we also report results series for GDP and the GDP deflator that are aggregated using exchange rate based variable weights as in Beyer, Doornik and Hendry (2001).

All series, except the unemployment rate and interest rates, have been transformed into logarithms before being filtered. The availability and the quality of the data on which the euro area aggregates are based differs from country to country. For instance, a majority of series is available back to 1970, while monetary aggregate series and retail bank interest rates are available only back to 1980. But there are exceptions to these general rules. An exhaustive report of the exact sources and time coverage for each time series is given in the appendix of this chapter.

[4] We are grateful to Jérôme Henry and to Alistair Dieppe, of the Econometric Modelling Division of the ECB, for giving us their data for the euro area aggregates and for sharing their procedures to built historical series for the national account variables.

[5] Availability and source are listed in appendix 2 in Agresti and Mojon (2001).

[6] For euro area variables, a complete description of the methodology and the variables used to construct the AWM database is in annex 2 of Fagan, Henry and Mestre (2001). This paper represents the current version of the area-wide model for the euro area that has been developed by the ECB staff in the Econometric Modelling Division.

4 The business cycle in the euro area

4.1 Business cycles of the euro area and EMU countries

We briefly review the correlations of each national business cycle with the aggregate euro area cycle. There are already many studies that have addressed this issue with various methodologies,[7] and reviewing them all is beyond the scope of this chapter.

We just want to stress that Forni and Reichlin (2001) have shown that when the business cycle of European regions is decomposed into a European component, a national component and a regional component, the European component had a larger role than the national ones. The share of the European regions' GDP variance that is explained by the common European business cycle range between 40 and 60 per cent for most countries of the euro area (Portugal and Greece being the exception) while the share of the national components range between 20 and 35 per cent. The rest of the variance is driven by the regions' idiosyncratic components.

To explore these issues further, we report the cross-correlations of the country cycles and the euro area aggregate cycle. We focus on four variables: GDP, consumption, investment and the short-term interest rate.

As can be seen in panel A of table 1.1, the contemporaneous correlations of euro area and national GDP are relatively high, between 0.7 and 0.92 for most of the countries. For Greece, Portugal and Finland, the correlation drops to around 0.4. Panels B and C report similar measures for respectively consumption and investment. Both consumption and investment of most European countries is highly correlated with euro area consumption or investment. Panel D shows the fairly high correlations between short-term interest rates in the euro area.

Two additional results of table 1.1 are worth stressing. First, the high correlations between national GDP, consumption, investment and interest rates with respect to their euro area counterparts do not merely reflect an international business cycle. The last three columns of each

[7] First, empirical studies on optimal currency areas have compiled the country pair-wise cross-correlation of VAR-based supply and demand shocks. For a survey of this literature, see Bayoumi and Eichengreen (1996). Second, some studies aim at characterising a European business cycle by weighting countries; business cycles. A recent example of this line of research is the paper of Altissimo *et al.* (2001). The authors apply dynamic factor models to selected series from the six largest euro area countries, and obtain an indicator that tracks the euro area GDP relatively closely. See also Artis, Krolzig and Toro (1999). Third, the literature on international business cycles has produced a number of results on the synchronicity of European business cycles. See for instance the references in Baxter (1995).

Table 1.1 *Synchronicity of fluctuations for selected variables of the Euro area countries*

Panel A

	St. dev			Cross-correlation							
	absolute	relative		with euro area GDP $(t+k)$					with GDP (t)		
GDP (t) of		GDP	euro area	k -4	-1	0	1	4	own	euro area	US
euro area	0.90	1	0.9	−0.20	0.89	1.00	0.89	−0.18	1.00	1.00	0.47
DE	1.06	1	1.0	−0.29	0.69	0.88	0.88	0.06	1.00	0.87	0.57
FR	079	1	0.7	−0.18	0.81	0.89	0.76	−0.18	1.00	0.88	0.36
IT	1.41	1	1.3	−0.18	0.86	0.92	0.76	−0.36	1.00	0.91	0.38
ES	0.85	1	0.8	0.13	0.74	0.71	0.56	−0.15	1.00	0.71	0.18
BE	0.90	1	0.9	−0.14	0.75	0.89	0.84	−0.03	1.00	0.88	0.26
NL	0.65	1	0.7	0.03	0.66	0.69	0.58	0.04	1.00	0.72	0.59
FI	1.42	1	1.3	−0.17	0.37	0.46	0.48	0.31	1.00	0.45	0.21
AT	0.84	1	0.8	0.17	0.72	0.70	0.55	−0.07	1.00	0.69	−0.17
PT	1.08	1	1.0	0.36	0.41	0.40	0.35	0.09	1.00	0.35	−0.45
GR	1.04	1	1.0	0.22	0.44	0.39	0.27	−0.27	1.00	0.35	−0.45
Countries av.*	**1.00**	**1**	**1.0**	**0.00**	**0.64**	**0.69**	**0.60**	**−0.06**	**1.00**	**0.68**	**0.15**
USA	1.35	1	1.5	−0.34	0.25	0.48	0.60	0.29	1.00	0.47	1.00

Panel B

	St. dev			Cross-correlation							
	absolute	relative		with euro area investment $(t+k)$					with GDP (t)		
Investment (t) of		GDP	euro area	k -4	-1	0	1	4	own	euro area	US
euro area	1.99	2.2	1.0	0.05	0.92	1.00	0.92	0.07	1.00	0.86	0.31
DE	2.41	2.3	1.2	−0.27	0.60	0.78	0.82	0.24	0.81	0.67	0.50
FR	2.12	2.7	1.1	0.00	0.75	0.84	0.78	0.10	0.87	0.82	0.30
IT	2.78	2.0	1.4	0.34	0.91	0.86	0.67	−0.19	0.76	0.75	0.22
ES	2.95	3.5	1.5	0.10	0.66	0.72	0.66	0.08	0.82	0.75	0.22
BE	2.62	2.9	1.3	0.17	0.52	0.52	0.45	0.21	0.52	0.57	0.33
NL	2.01	3.1	1.0	0.44	0.52	0.39	0.22	−0.06	0.62	0.50	0.29
FI	4.36	3.1	2.2	0.06	0.56	0.58	0.52	0.13	0.81	0.45	−0.05
AT	2.48	2.9	1.2	0.05	0.52	0.58	0.54	0.05	0.68	0.47	0.06
PT	4.40	4.1	2.2	0.40	0.58	0.42	0.21	−0.22	0.70	0.30	−0.32
GR	2.72	2.6	1.4	0.32	0.26	0.18	0.10	0.15	0.19	0.33	0.29
Countries av.*	**2.88**	**2.9**	**1.4**	**0.16**	**0.59**	**0.59**	**0.50**	**0.05**	**0.68**	**0.63**	**0.26**
USA	4.19	3.1	2.1	−0.08	0.19	0.22	0.22	0.14	−0.40	−0.33	−0.40

Table 1.1 *(cont.)*

Panel C

Consumption (t) of	St. dev			Cross-correlation							
	absolute	relative		with euro area consumption ($t+k$)					with GDP (t)		
		GDP	euro area	k -4	-1	0	1	4	own	euro area	US
euro area	0.59	0.7	1.0	0.08	0.92	1.00	0.92	0.09	1.00	0.79	0.35
DE	0.78	0.7	1.3	0.07	0.57	0.69	0.72	0.32	0.60	0.29	0.29
FR	0.81	1.0	1.4	−0.31	0.44	0.62	0.68	0.28	0.59	0.42	0.35
IT	1.11	0.8	1.9	0.20	0.84	0.80	0.62	−0.21	0.80	0.83	0.23
ES	0.85	1.0	1.4	0.13	0.74	0.71	0.56	−0.15	0.75	0.71	0.16
BE	0.72	0.8	1.2	−0.01	0.57	0.71	0.74	0.29	0.69	0.70	−0.16
NL	0.96	1.5	1.6	0.45	0.64	0.58	0.48	0.17	0.49	0.50	0.03
FI	1.31	0.9	2.2	−0.31	0.24	0.39	0.47	0.33	0.79	0.52	−0.01
AT	0.93	1.1	1.6	0.14	0.47	0.41	0.26	−0.29	0.61	0.35	−0.20
PT	1.51	1.4	2.6	0.64	0.44	0.33	0.22	−0.14	0.50	0.05	−0.56
GR	1.07	1.0	1.8	−0.08	0.18	0.22	0.21	0.10	0.72	0.05	−0.56
Countries av.*	**1.01**	**1.0**	**1.7**	**0.09**	**0.51**	**0.55**	**0.50**	**0.07**	**0.65**	**0.44**	**−0.04**
USA	1.03	0.8	1.7	−0.36	0.20	0.35	0.44	0.24	0.85	0.32	0.85

Panel D

Short-term rate (t) of	St. dev			Cross-correlation							
	absolute	relative		with euro area short-term rate ($t+k$)					with GDP (t)		
		GDP	euro area	k -4	-1	0	1	4	own	euro area	US
euro area	1.18	1.3	1.0	−0.28	0.87	1.00	0.87	−0.26	1.00	0.61	0.15
DE	1.47	1.4	1.2	−0.38	0.58	0.81	0.87	0.19	0.55	0.65	0.39
FR	1.44	1.8	1.2	−0.14	0.90	0.94	0.73	−0.45	0.51	0.51	0.04
IT	1.81	1.3	1.5	−0.16	0.74	0.80	0.63	−0.40	0.57	0.38	−0.17
ES	1.62	1.9	1.4	−0.12	0.92	0.87	0.58	−0.66	0.19	−0.11	−0.09
BE	0.79	0.9	0.7	−0.07	0.57	0.56	0.46	−0.07	0.32	0.22	0.22
NL	1.38	2.1	1.2	0.19	0.60	0.55	0.42	−0.19	0.30	0.36	−0.03
FI	1.39	1.0	1.2	−0.21	0.55	0.64	0.63	0.16	0.32	0.37	−0.11
AT	1.03	1.2	0.9	0.24	0.75	0.71	0.57	−0.05	0.05	0.22	0.12
PT	0.71	0.7	0.6	0.01	0.49	0.56	0.54	0.13	0.53	0.69	−0.21
GR	0.55	0.5	0.5	−0.05	−0.55	−0.53	−0.41	0.10	−0.37	−0.35	0.03
Countries av.*	**1.19**	**1.3**	**1.0**	**−0.04**	**0.55**	**0.57**	**0.46**	**−0.16**	**0.36**	**0.32**	**0.03**
USA	1.40	1.0	1.2	−0.48	0.01	0.25	0.42	0.40	0.48	0.51	0.48

Notes: Standard deviation of and cross-correlation between the business cycle component (BCC) of individual time series (GDP, Consumption, investment and three-month interest rate of the countries). The BCC was obtained from a band pass filter BPF(6,40,8) *à la* Baxter and King (1999) as described in appendix 1 of Agresti and Mojon (2001). The euro area synthetic data, which were built for the ECB AWM, are aggregates of the eleven countries that initially adopted the euro, in January 1999. The series have not yet been backdated to include Greece, which joined the monetary union in January 2001.

*Average of country values with 1995 PPP GDP weights.

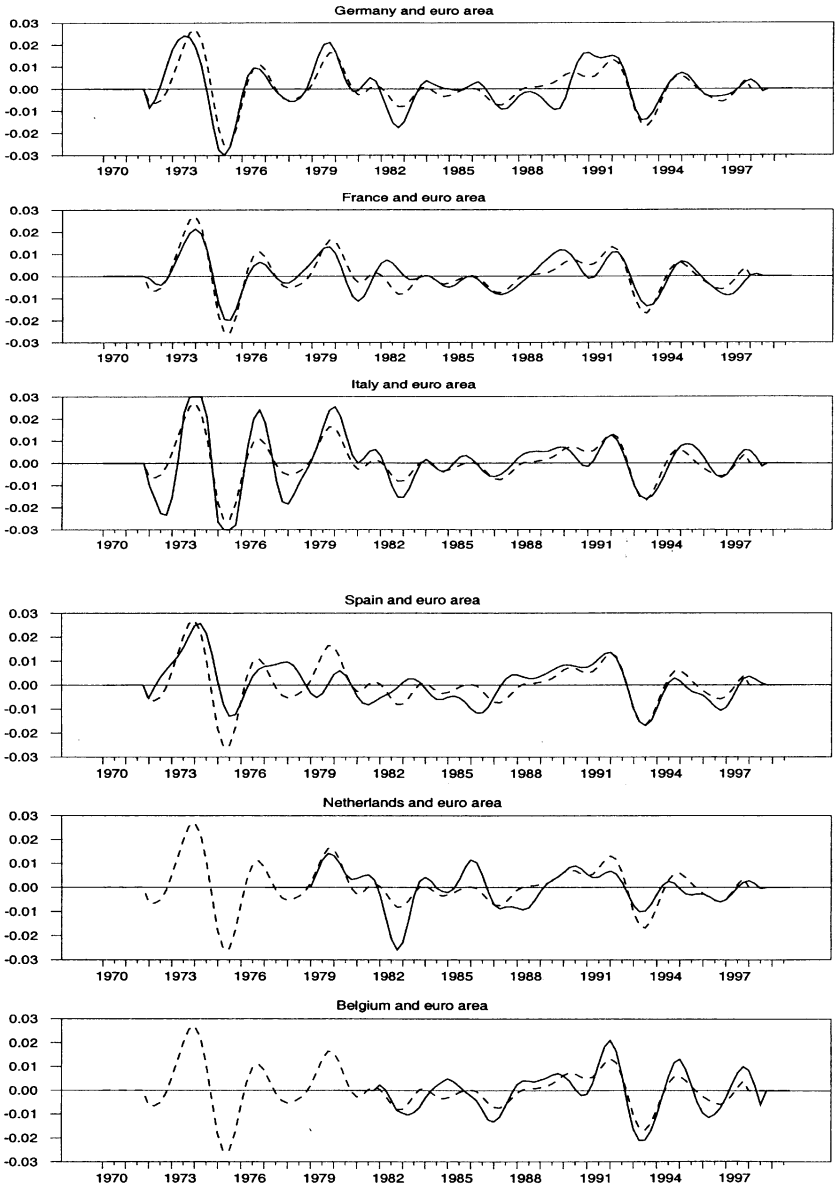

Figure 1.3 Business cycle component (using a Baxter and King (6,40,8) filter) of GDP for EMU countries (solid line) and the euro area (dotted line), 1973–1997

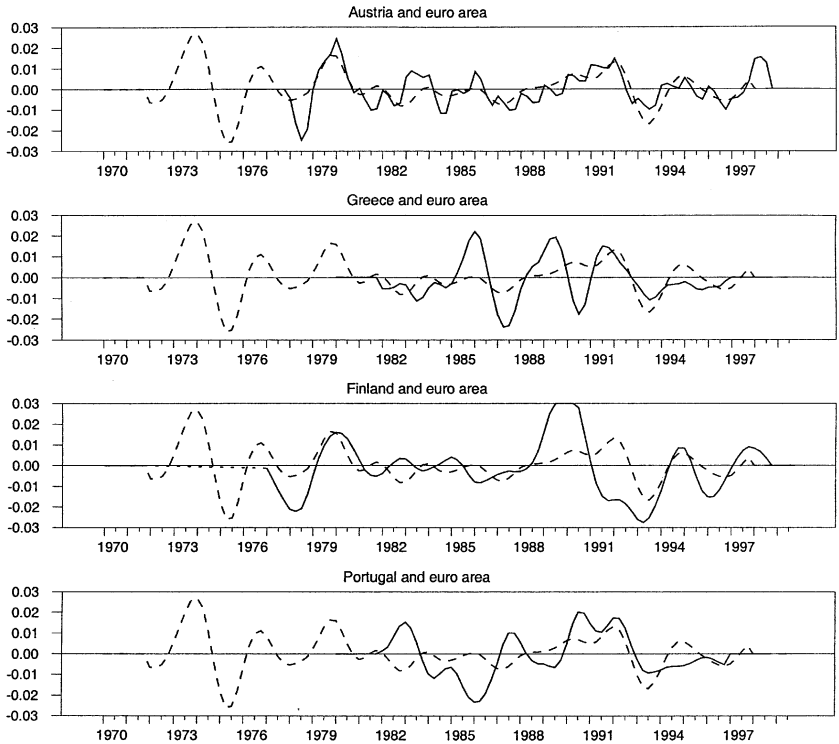

Figure 1.3 (*cont.*)

panel show that the correlation of national cycles with the US business cycle, albeit positive for most countries, is markedly smaller than the ones observed with the euro area cycle.

Secondly, the US norm of consumption being less volatile than GDP and investment being more volatile does not hold for all countries. This puzzling finding, which can partly be explained by the fact that private consumption includes durable consumption is, however, not unusual. Baxter (1995) reports that consumption fluctuations are larger than GDP fluctuations for Japan and for the UK and nearly as large for France.

We now turn to a graphical description of the cyclical components of national and euro area GDP series (figure 1.3). It is particularly interesting to stress some specific periods where each country deviated from the rest of the euro area. For example, during the German reunification, the German cycle diverged significantly from the euro area one. In

France, the most striking deviation occurred around the fiscal expansion undertaken after the 1981 elections. The Spanish business cycle appears to 'converge' with the area cycle after 1986, the date when Spain joined the European Community (EC). The Finnish financial deregulation of the second part of the 1980s and the trade shock after the collapse of the Soviet Union mark the largest deviations of the Finnish business cycle. Italy, although highly synchronised with the area business cycle throughout the sample period, experienced much larger fluctuations in the 1970s. This is probably due to the heavy Italian reliance on imported oil. The Italian fluctuations subsequently decreased as the share of energy-related imports declined dramatically during the 1980s.

Altogether, this evidence suggests that the national and the euro area business cycles are fairly synchronised. Wynne and Koo (2000) have nevertheless stressed that the cross-correlation between the business cycles (of GDP, of prices or of employment) of the twelve US Federal Reserve districts are still much higher than the cross-correlation of the business cycles of the fifteen EU countries. Unfortunately we do not have data to carry out this comparison with the Federal Reserve districts before they integrated a formal monetary union at the beginning of the twentieth century. As conjectured by Bentoglio, Fayolle and Lemoine (2001), the monetary union could lead to an increase in the synchronicity of the business cycle of countries participating in EMU.[8]

4.2 Aggregation

We now show evidence that the aggregation method chosen to build euro area aggregates has only second-order implications for the business cycle properties of the euro area GDP. As discussed in section 3, the aggregation of country macroeconomic variables into euro area aggregates is based on summing national growth rates with weights that are proportional to PPP GDP in 1995. The major drawback of this approach to aggregation is that it may introduce distortions in periods of large changes in 'intra-euro area' exchange rates. Another aggregation approach, using weights that vary over time with the exchange rates, has been proposed by Beyer, Doornik and Hendry (2001) (BDH aggregation in table 1.2).

[8] Bentoglio, Fayolle and Lemoine (2001) show that interest shocks tended to be asymmetric across countries in the period prior to EMU. Mojon and Peersman (chapter 3 in this volume) also show that the monetary policy shocks were asymmetric across countries in the early 1990s, especially around the EMS crisis. Angeloni and Dedola (1999) show that the synchronicity between European countries business cycles has increased over time. Finally, Frankel and Rose (2001) show that monetary unions have a stimulating impact on trade among its members.

Table 1.2 *Cyclical properties of the alternative synthetic euro area macroeconomic time series, 1970–2000*

	St. dev			Cross-correlation with GDP ($t + k$)								
variables (t)	absolute	relative/GDP	k	−4	−3	−2	−1	0	1	2	3	4
Alternative aggregations												
GDP, AWM[a], 80:99	0.61	0.7		−0.01	0.30	0.64	0.90	1.00	0.90	0.63	0.29	−0.01
GDP, BDH[b], 80:99	0.62	0.7		−0.04	0.28	0.62	0.88	0.99	0.90	0.65	0.32	0.03
GDP deflator (level) AWM	0.67	0.5		0.00	−0.16	−0.31	−0.42	−0.48	−0.49	−0.46	−0.42	−0.39
GDP deflator (level), BDH	0.45	0.5		0.10	0.05	−0.02	−0.11	−0.21	−0.33	−0.44	−0.53	−0.57
Other economic activity indicators												
Industrial production	1.57	1.9		−0.18	0.16	0.52	0.82	0.96	0.89	0.66	0.35	0.03
Unemployment	4.66	5.6		−0.24	−0.55	−0.79	−0.89	−0.81	−0.58	−0.26	0.08	0.34

Note: See table 1.1.

[a] AWM refers to the Area Wide Model where the aggregation is based on fixed weights as in Fagan, Henry and Mestre (2001).

[b] BDH Aggregation based on variable weights as proposed by Beyer, Dooornik and Hendry (2001).

Table 1.2 shows the cross-correlation of the band pass filtered euro area GDPs obtained with the two alternative aggregation methods over the sample period from 1980 to 1999 with the benchmark euro area GDP filter for the full sample of the last thirty years. It also reports their respective standard deviations. Both the standard deviation and the cross-correlations of the two measures of euro area GDP indicate that the type of weights used in the aggregation have a very small impact on the business cycle fluctuations of the aggregate. This is also reflected in the similarity of the standard deviation and the cross-correlation *vis-à-vis* GDP of the GDP deflator, aggregated following the two methods.

Hence the business cycle properties of the euro area aggregates do not depend on the aggregation method (either fixed or variable exchange rates-based weights to country time series) used to construct these aggregates.[9] This conclusion is further supported by Labhard, Weeken and Westaway (2001), who compared time-series analyses of the euro area economy based on alternative aggregation methods.

Finally table 1.2 also reports evidence of the very high correlation of the euro area GDP aggregate with two other key indicators of economic activity: industrial production and the unemployment rate. Following Stock and Watson (1999), we take this result as a confirmation that euro area GDP is a good benchmark to describe the cyclical properties of other euro area macroeconomic variables.

5 Comparing the euro area and the US business cycle

5.1 Euro area and US *growth and business cycle*

To start with, we compare the movements in GDP for the euro area with those for the USA. The average annual GDP growth in the USA from 1970 to 1999 is slightly higher (3.3 per cent against 2.7 per cent). However, for the same period, the growth of the population has been much larger in the USA (34 per cent in total or nearly 1 per cent per annum) than in the euro area (11 per cent in total or 0.3 per cent per annum).

The spectral density of the euro area GDP growth reaches its peak for cycles of five years duration, while for the USA the maximum is reached

[9] Actually, the aggregate euro area series built with the two aggregation methods can differ only if major growth or inflation asymmetries across countries have taken place at the time of the largest intra-exchange rate fluctuations. Moreover, these asymmetries should occur for large enough countries to be noticeable at the level of euro area aggregates.

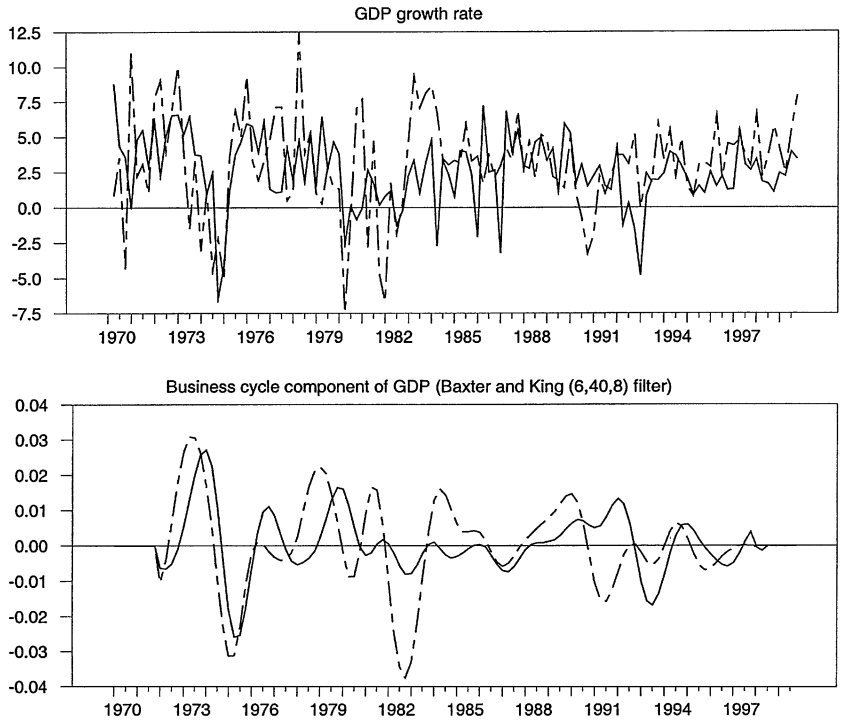

Figure 1.4 Business cycle in the euro area (solid line) and in the USA (dotted line), 1973–1997

at zero frequencies (figure 1.1).[10] The common wisdom, that Europe is less cyclical than the USA (Forni and Reichlin, 2001), is based on sample periods that (as shown in figure 1.2) do not include the second half of the 1990s. As shown in figure 1.4, which reports the growth rate of GDP and the its business cycle component as obtained by the Baxter and King band pass filter, economic activity in the USA has recently been less cyclical than in the euro area and less cyclical than it used to be.[11]

Figure 1.4 also shows the sequence of long periods of increases and short periods of declines of output that characterises these two economies. There are some similarities in the timing of their cyclical patterns as well. They both fell into recession between 1973 and 1975 and the two US

[10] We still obtain a peak at zero frequency when the spectral density is computed on a time series of GDP spanning from 1970 to 2002 Q2, i.e. when including the 2001 US recession.

[11] McConnell and Perez-Quiros (2000) have already described this result.

Table 1.3 *Cyclical properties of the euro area, 1970–2000*

		St. dev			Cross-correlation with GDP $(t+k)$								
variables (t)		absolute	relative/GDP	k	−4	−3	−2	−1	0	1	2	3	4
GDP	1	0.84	1.0		−0.19	0.18	0.58	0.88	1.00				
Consumption	2	0.55	0.7		−0.13	0.09	0.37	0.63	0.79	0.80	0.66	0.40	0.09
Investment	3	1.85	2.2		0.06	0.34	0.62	0.81	0.86	0.75	0.51	0.21	−0.09
Cumulated inventories	4	2.40	2.9		0.65	0.83	0.82	0.59	0.22	−0.19	−0.52	−0.70	−0.70
GDP deflator (level)	5	0.58	0.7		0.29	0.27	0.16	−0.04	−0.30	−0.55	−0.72	−0.76	−0.67
CPI (level)	6	0.68	0.8		0.28	0.26	0.16	−0.03	−0.26	−0.50	−0.66	−0.72	−0.66
CPI (inflation)	7	0.31	0.4		0.35	0.34	0.27	0.21	0.20	0.26	0.31	0.30	0.19
Stock prices	8	12.00	0.1		−0.10	−0.07	−0.01	0.05	0.08	0.06	0.01	−0.03	−0.02
Real estate prices	9	1.36	1.6		0.53	0.52	0.50	0.45	0.39	0.31	0.20	0.06	−0.08
Short-term rate nominal	10	1.09	1.3		0.27	0.54	0.73	0.76	0.61	0.30	−0.08	−0.43	−0.67
Short-term rate real	11	0.76	0.9		0.49	0.65	0.68	0.55	0.26	−0.11	−0.43	−0.61	−0.59
Long-term rate nominal	12	0.57	0.7		0.22	0.38	0.48	0.47	0.33	0.09	−0.17	−0.37	−0.46
Yield curve	13	0.83	1.0		−0.20	−0.45	−0.63	−0.68	−0.58	−0.34	−0.01	0.32	0.56
Real ef. exchange rate	14	3.58	4.3		0.22	0.33	0.36	0.30	0.17	0.01	−0.12	−0.18	−0.18
DM–USD exchange rate	15	5.23	6.2		0.13	0.36	0.56	0.61	0.48	0.22	−0.08	−0.34	−0.46
M1	16	1.00	1.2		−0.22	−0.26	−0.20	−0.05	0.16	0.39	0.58	0.68	0.67
M3	17	0.72	0.9		0.45	0.23	0.01	−0.17	−0.26	−0.27	−0.19	−0.06	0.07
Total loans	18	0.85	1.0		0.59	0.55	0.48	0.37	0.23	0.10	0.00	−0.06	−0.08
					Cross-correlation with own $(t+k)$								
CPI (level)	19	0.68	0.8		0.33	0.55	0.77	0.94	1.00				
GDP deflator	20	0.31	0.4		0.27	0.50	0.74	0.93	1.00				

Note: See table 1.1.

Table 1.4 *Cyclical properties of the USA, 1970–2000*

variables (t)		St. dev absolute	St. dev relative/GDP	k	Cross-correlation with GDP ($t+k$) −4	−3	−2	−1	0	1	2	3	4
GDP	1	1.34	1.0		−0.09	0.24	0.60	0.89	1.00	0.89	0.59	0.23	−0.09
Consumption	2	1.01	0.8		−0.24	0.03	0.34	0.64	0.84	0.87	0.74	0.51	0.27
Investment	3	3.26	2.4		0.11	0.44	0.75	0.94	0.95	0.80	0.53	0.20	−0.10
Cumulated inventories	4	2.35	1.8		0.74	0.89	0.88	0.69	0.35	−0.02	−0.32	−0.48	−0.48
GDP deflator (level)	5	0.67	0.5		0.00	−0.16	−0.31	−0.42	−0.48	−0.49	−0.46	−0.42	−0.39
CPI (level)	6	1.02	0.8		0.23	0.10	−0.07	−0.24	−0.41	−0.52	−0.56	−0.54	−0.49
CPI (inflation)	7	1.29	1.0		0.48	0.59	0.63	0.56	0.38	0.15	−0.09	−0.25	−0.31
Stock prices	8	7.92	5.9		−0.50	−0.50	−0.37	−0.12	0.16	0.39	0.47	0.40	0.22
Real estate prices	9	2.12	1.6		−0.18	−0.21	−0.16	−0.06	0.08	0.21	0.24	0.17	0.03
Short-term rate nominal	10	1.31	1.0		0.38	0.56	0.68	0.67	0.50	0.21	−0.14	−0.44	−0.62
Short-term rate real	11	1.11	0.8		−0.11	−0.03	0.07	0.14	0.15	0.07	−0.06	−0.22	−0.36
Long-term rate nominal	12	0.82	0.6		−0.03	0.14	0.28	0.35	0.30	0.14	−0.07	−0.28	−0.41
Yield curve	13	0.90	0.7		−0.51	−0.60	−0.63	−0.56	−0.39	−0.15	0.12	0.33	0.45
Real ef. exchange rate	14	2.96	2.2		0.08	0.11	0.08	0.00	−0.07	−0.12	−0.12	−0.08	−0.01
DM–USD exchange rate	15	6.66	5.0		0.19	0.23	0.23	0.23	0.27	0.37	0.45	0.42	0.27
M1	16	1.78	1.3		−0.22	−0.23	−0.18	−0.08	0.05	0.16	0.22	0.24	0.22
M3	17	0.87	0.7		0.25	0.37	0.42	0.39	0.28	0.12	−0.03	−0.13	−0.15
Total loans	18	1.99	1.5		0.75	0.78	0.68	0.48	0.19	−0.11	−0.34	−0.45	−0.45
					Cross correlation with own ($t+k$)								
CPI (level)	19	1.02	0.8		0.38	0.61	0.81	0.95	1.00				
GDP deflator	20	1.29	1.0		0.35	0.58	0.80	0.95	1.00				

Note: See table 1.1.

recessions of the early 1980s are mirrored by a slowdown in the euro area. There was some divergence in the 1990s, as the American recession in 1991 during the Gulf War did not coincide with a slowdown in the euro area (which was buoyed by the fiscal stimulus in Germany following reunification). However, 1993 was the most severe recession of the post-Second World era for many European countries.

The phases of the two growth cycles are quite similar. The US business fluctuations are more volatile for most of the sample period. The standard deviation of the US GDP business cycle fluctuations is 50 per cent higher than the euro area one. However this seems to have changed after 1992. We also observe that the US cycle tends to lead the euro area cycle. The cross-correlation of the two business cycles is the highest between US GDP (t) and euro area GDP ($t + 2$ or $t + 3$) which is consistent with the euro area business cycle lagging the US cycle by two–three quarters.[12]

5.2 *Further similarities with the* US *business cycle*

The business cycle properties of a number of euro area variables (table 1.3) are very much like those observed over the corresponding US variable (table 1.4). The following is a list of the characteristics that are similar in the two economies.

First, consumption and investment series are pro-cyclical while inventories[13] are slightly lagging aggregate activity (usually by two–three quarters). Second, consumption is smoother than output while investment is more than twice as volatile as output.[14] Third, the levels of the CPI and GDP deflator are counter-cyclical, while inflation is pro-cyclical. However the correlations with current GDP are hardly significant.[15] The cross-correlation of price levels with future GDP are much larger. Higher price levels are followed, two–three quarters later, by a decline in GDP.

Fourth, the persistence of the price-levels business cycle components is very high. Fifth, all interest rates (short-term nominal, short-term real

[12] The leads and lags of two and three quarters are not reported in table 1.1 for the sake of tractability and readability. These results are available from the authors upon request.

[13] In most countries of the euro area are measured as a residual in the national accounts. In Italy, in France and in the Netherlands, inventory series are also based on surveys.

[14] We do not report statistics for imports and exports *vis-à-vis* non-euro area countries because they are available only back to the late 1980s.

[15] The standard deviation of the correlation coefficient is about 0.1 for series available back to 1970 and about 0.16 for variables available only since 1980.

Table 1.5 *Business fluctuations of the euro area*[a]

		Euro area economy (1970–2000)							
		BXKG(6,32,8)*							
		St. dev		Cross-correlation with GDP ($t+k$)					
Variables (t)		absolute	relative/GDP	k	-4	-1	0	1	4
GDP	1	0.87	1.00		−0.22	0.88	1.00		
Consumption	2	0.57	0.65		−0.18	0.64	0.80	0.82	0.03
Investment	3	1.91	2.18		0.04	0.82	0.87	0.75	−0.17
CPI (level)	4	0.69	0.79		0.30	−0.07	−0.32	−0.54	−0.59
CPI (inflation)	5	0.95	1.09		0.02	0.69	0.67	0.49	−0.47
Short-term rate nominal	6	1.14	1.30		0.26	0.78	0.63	0.32	−0.65
					Cross-correlation with own ($t+k$)				
CPI (level)	7	0.69	0.79		0.29	0.93	1.00		
		BXKG(6,40,12)*							
		St. dev		Cross-correlation with GDP ($t+k$)					
Variables (t)			relative/GDP	k	-4	-1	0	1	4
GDP	1	1.14	1.00		0.23	0.93	1.00		
Consumption	2	0.89	0.78		0.33	0.75	0.81	0.80	0.30
Investment	3	2.92	2.57		0.43	0.90	0.91	0.83	0.19
CPI (level)	4	1.19	1.04		−0.06	−0.38	−0.49	−0.59	−0.61
CPI (inflation)	5	1.43	1.26		0.36	0.61	0.57	0.43	−0.31
Short-term rate nominal	6	1.28	1.13		0.52	0.68	0.53	0.29	−0.47
					Cross-correlation with own ($t+k$)				
CPI (level)	7	1.19	1.04		0.60	0.97	1.00		
		HP filter 1600*							
		St. dev		Cross-correlation with GDP ($t+k$)					
Variables (t)			relative/GDP	k	-4	-1	0	1	4
GDP	1	1.05	1.00		0.19	0.86	1.00		
Consumption	2	0.83	0.79		0.26	0.65	0.80	0.74	0.33
Investment	3	2.72	2.59		0.37	0.82	0.89	0.78	0.27
CPI (level)	4	1.10	1.04		0.06	−0.30	−0.45	−0.59	−0.70
CPI (inflation)	5	1.48	1.41		0.23	0.46	0.39	0.28	−0.25
Short-term rate nominal	6	1.30	1.24		0.51	0.66	0.52	0.28	−0.46
					Cross-correlation with own ($t+k$)				
CPI (level)	7	1.10	1.04		0.55	0.94	1.00		

(*cont.*)

Table 1.5 *(cont.)*

	US economy (1970–2000)						
	BXKG(6,32,8)*						
	St. dev			Cross-correlation with GDP $(t+k)$			
	absolute	relative/GDP	k	−4	0	1	4
1	1.26	1.00		−0.08	1.00		
2	0.97	0.77		−0.19	0.85	0.87	0.18
3	3.18	2.53		0.11	0.95	0.79	−0.18
4	0.99	0.79		0.18	−0.49	−0.58	−0.39
5	1.24	0.99		0.31	0.58	0.41	−0.26
6	1.26	1.00		0.38	0.54	0.26	−0.64
				Cross-correlation with own $(t+k)$			
7	0.99	0.79		0.39	1.00		
	BXKG(6,40,12)*						
	St. dev			Cross-correlation with GDP $(t+k)$			
	absolute	relative/GDP	k	−4	0	1	4
1	1.76	1.00		0.27	1.00		
2	1 .44	0.82		0.07	0.89	0.93	0.65
3	4.90	2.78		0.33	0.96	0.88	0.35
4	1.70	0.96		0.12	−0.51	−0.63	−0.76
5	1 .34	0.76		0.55	0.58	0.45	−0.02
6	1 .82	1 .03		0.59	0.31	0.07	−0.56
				Cross-correlation with own $(t+k)$			
7	1.70	0.96		0.53	1.00		
	HP filter 1600*						
	St. dev			Cross-correlation with GDP $(t+k)$			
	absolute	relative/GDP	k	−4	0	1	4
1	1.63	1.00		0.27	1.00		
2	1.36	0.83		0.07	0.87	0.90	0.52
3	4.45	2,72		0.32	0.95	0.85	0.28
4	1.53	0.94		0.10	−0.59	−0.72	−0.69
5	2.00	1.22		0.47	0.47	0.38	−0.16
6	1.80	1.10		0.53	0.34	0.08	−0.56
				Cross-correlation with own $(t+k)$			
7	1.53	0.94		0.50	1.00		

Notes: Standard deviation of and cross-correlation between the BCC of individual time series (GDP, Consumption, Investment and three-month interest rate of the countries). The BCC was obtained from the Band Pass filter BPF(6,40,8), BPF(6,32,8) and BPF(6,40,12) *à la* Baxter and King (1999) as described in appendix 1 of Agresti and Mojon (2001) as well as with the HP filter with a 1600 weight.

and long-term nominal) are pro-cyclical, while the yield curve (long-term rate–short-term rate) is counter-cyclical. The cross-correlation between interest rates and output reaches a maximum positive value near lag zero or a small negative lag.

Sixth, all interest rates lead GDP slowdowns by about a year. Seventh, among the three interest rates, the nominal short-term interest rate appears to have the highest negative correlation with future GDP. Eighth, an appreciation (depreciation) of the US dollar–DM exchange rate leads economic activity in the euro area (the USA) by about three quarters.

Before turning to the differences in the euro area and the US business cycle, it is worth stressing that (as shown in table 1.3) these similarities between the USA and the euro area do not depend on the filter used.

5.3 Differences with the US business cycle

There are also some differences between the two economies. First, stock prices are leading GDP by two quarters in the USA but not in the euro area. This is not necessarily surprising if one considers the small role traditionally played by the stock market in continental Europe. We also observe a few other differences (e.g. the correlation between past GDP and current inflation tends to be lower in the euro area; the M1 lead of GDP is much stronger in the euro area than in the USA; and real estate prices are lagging GDP in the euro area but not in the USA). However, these do not lend themselves to straightforward interpretations.

6 Conclusion

This chapter has put together a set of stylised facts about the euro area economy and how these compare to the USA and the individual countries that form the euro area. The main finding is that the business cycle of the euro area aggregate is strikingly similar to the US business cycle in a number of respects. The phase of the business cycle, the magnitude of consumption and investment fluctuations relative to GDPs, the leading, coincident or lagging correlations of GDP with consumption, investment, prices, inflation, interest rates, and finally the persistence of prices are very similar in the USA and in the euro area. We also describe the very high synchronicity between the euro area business cycle and the business cycle of the countries that form the euro area.

APPENDIX

Table 1.6 *Summary table on data source and availability*

Definition	Main source[b]	Availibility euro area	Austria	Belgium	Germany
National accounts					
GDP REAL	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Private consumption	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Durables	OECD-QNA	na	na	na	na
Non-durables	OECD-QNA	na	na	na	na
Investment	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Residential	OECD-QNA	na	na	80q1–99q3	91q1–00q3
Non-residential	OECD-QNA	na	na	80q1–99q3	91q1–00q3
Change in inventories	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Cumulated change in inventories	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Total (intra- and extra-euro area) exports	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Total (intra- and extra-euro area) imports	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Government consumption	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
GDP deflator	OECD-QNA	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Consumption deflator		70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Other data					
CPI	IMF	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Industrial production index	IMF	85q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Share prices (IMF)	IMF	80q1–99q4			
Share prices (OECD)	OECD		77q1–00q3	85q1–00q3	70q1–00q3
Unemployment (BIS)	BIS	70q1–99q4	77q1–00q3		
Unemployment (OECD)	OECD			85q1–00q3	70q1–98q3
Real estate prices	ECB	80q1–99q4	76q1–99q4	85q1–99q4	72q1–00q3
Interest rates					
Short-term money market	AWM and ECB	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Long-term bond	AWM and ECB	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Retail interest rate on house purchase loans[a]	ECB	90q1–99q4	95q1–00q3	80q1–00q3	80q1–00q3
Retail rate on short-term loans to firms[a]	ECB	90q1–99q4	95q1–00q3	80q1–00q3	80q1–00q3
Retail rate on Time deposits[a]	ECB	90q1–99q4	95q1–00q3	80q1–00q3	80q1–00q3
Monetary aggregates					
Total loans	ECB	82q4–99q4	83q1–00q3	83q1–00q3	80q1–00q3
M1	ECB	80q1–99q4	80q1–00q3	80q1–00q3	80q1–00q3
M3	ECB	80q1–99q4	80q1–00q3	80q1–00q3	80q1–00q3
Loans to firms	NCB's	na	81q1–00q3	80q1–00q3	78q1–00q3
Loans to households	NCB's	na	81q1–00q3	80q1–00q3	78q1–00q3
Exchange rates					
Real effective exchange rate	BIS	70q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
Exchange rates *vis-à-vis* DEM	BIS	na	76q1–00q3	80q1–00q3	na
Exchange rates *vis-à-vis* US Dollar	BIS	79q1–99q4	76q1–00q3	80q1–00q3	70q1–00q3
World market prices, raw materials, total Index	BIS	70q1–00q3	70q1–00q3	70q1–00q3	70q1–00q3
Private loans[c]	ECB	83q1–00q3	83q1–00q3	83q1–00q3	80q1–00q3

Notes: [a] At country level all data come from OECD_qna; except for PT, GR and BE, we received data from the NCBs.

Table 1.6 *(cont.)*

Spain	Finland	France	Greece	Italy	Netherlands	Portugal	United States
70q1–00q3	75q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3	80q1–98q4	70q1–00q3
70q1–00q3	75q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3	80q1–98q4	70q1–00q3
na	75q1–00q3	70q1–00q3	na	70q1–00q3	na	na	na
na	75q1–00q3	70q1–00q3	na	70q1–00q3	na	na	na
70q1–00q3	75q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3	80q1–98q4	70q1–00q3
na	75q1–00q3	70q1–00q3	na	na	77q1–00q3	na	70q1–00q3
na	75q1–00q3	70q1–00q3	na	na	77q1–00q3	na	70q1–00q3
70q1–00q3	75q1–00q3	70q1–00q3	na	70q1–00q3	77q1–00q3	na	70q1–00q3
70q1–00q3	75q1–00q3	70q1–00q3	na	70q1–00q3	77q1–00q3	na	70q1–00q3
70q1–00q3	75q1–00q3	70q1–00q3	na	70q1–00q3	77q1–00q3	na	na
70q1–00q3	75q1–00q3	70q1–00q3	na	70q1–00q3	77q1–00q3	na	na
70q1–00q3	75q1–00q3	70q1–00q3	na	70q1–00q3	77q1–00q3	na	na
70q1–00q3	75q1–00q3	70q1–00q3	na	70q1–00q3	77q1–00q3	na	70q1–00q3
70q1–00q3	75q1–00q3	70q1–00q3	na	70q1–00q3	77q1–00q3	80q1–98q4	na
70q1–00q3	70q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3	80q1–98q4	70q1–00q3
70q1–00q3	70q1–00q3	70q1–00q3		70q1–00q3	77q1–00q3	80q1–98q4	70q1–00q3
70q1–00q3	70q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3		70q1–00q3
		70q1–00q3				88q1–98q4	
70q1–00q3			80q1–98q4	70q1–00q3	77q1–00q3		
	84q1–00q3	70q1–98q3				83q1–98q4	
70q1–00q3	78q1–00q3	77q1–99q4		70q1–00q3	77q1–00q3	80q1–98q4	80q1–00q3
77q1–00q3	75q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3	80q1–98q4	70q1–00q3
78q1–00q3	75q1–00q3	70q1–00q3	85q1–98q4	70q1–00q3	77q1–00q3	85q1–98q4	70q1–00q3
80q1–00q3	80q1–00q3	90q1–00q3	80q1–98q4	89q1–00q3	80q1–00q3	90q1–98q4	
80q1–00q3	80q1–00q3	84q1–00q3	80q1–98q4	89q1–00q3	80q1–00q3	90q1–98q4	
80q1–00q3	80q1–00q3	80q1–00q3	80q1–98q4	89q1–00q3	80q1–00q3	90q1–98q4	
80q1–00q3	80q1–00q3	80q1–00q3	na	83q1–00q3	83q1–00q3	80q1–98q4	
80q1–00q3	80q1–00q3	80q1–00q3	80q1–98q4	80q1–00q3	80q1–00q3	80q1–98q4	70q1–00q3
80q1–00q3	80q1–00q3	80q1–00q3	80q1–98q4	80q1–00q3	80q1–00q3	80q1–98q4	70q1–00q3
83q1–00q3	89q1–00q3	78q1–00q3	80q1–98q4	80q1–00q3	80q1–00q3	80q1–98q4	
83q1–00q3	89q1–00q3	78q1–00q3	80q1–98q4	80q1–00q3	80q1–00q3	80q1–98q4	
70q1–00q3	70q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3	80q1–98q4	70q1–00q3
70q1–00q3	70q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3	80q1–98q4	70q1–00q3
70q1–00q3	70q1–00q3	70q1–00q3	80q1–98q4	70q1–00q3	77q1–00q3	80q1–98q4	78q1–00q3
70q1–00q3	70q1–00q3	70q1–00q3	70q1–00q3	70q1–00q3	70q1–00q3	70q1–00q3	70q1–00q3
80q1–00q3	80q1–00q3	80q1–00q3	80q1–00q3	83q1–00q3	83q1–00q3	80q1–00q3	70q1–00q3

[b] Eu-11 data come from the AWM, EMD ECB.
[c] For USA, data come from the IMF.